

## Diversity of Intertidal Benthic Invertebrate of Dokdo and Ulleung-do Island from Korea

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**Abstract:** In order to conduct a study on diversity of benthic invertebrate in the intertidal zone of Ulleung-do (Ulleungdo Island) and Dokdo, this study investigated the diversity of benthic invertebrate on harbor rocks of Ulleung-do (Jeodong Harbor), Tonggumi Mongdol Coast, Geobuk Bawi and rocks in Dokdo docks for twice in June and September. As a result, it was shown that total 26 species including 3 species of Cnidaria, 14 species of Mollusks, 6 species of Arthropod and 3 species of Echinoderm live in rocks of Dokdo docks, and as for Ulleung-do, it was shown that 24 species live on rocks of Tonggumi Mongdol Coast, 13 species in Geobuk Bawi and 2 species in Jeodong Harbor.

**Keywords:** Invertebrate, Ulleung-do Island, Dokdo Island

### Introduction

Ulleung-do (Ulleungdo Island) which is situated at the eastern extremity of South Korea belongs to Ulleung-gun, Gyeongsangbuk-do of the administrative district. The direct distance from east to west, and from south to north is 10 km and 9.5 km respectively, total extent is 73.5 km<sup>2</sup>, and it is a volcanic island created by large-sized volcanic activity in the continental shelf of the East Coast from the Miocene epoch to the Pleistocene epoch. Dokdo belongs to Dokdo-ri, Ulleung-eup, Ulleung-gun, Gyeongsangbuk-do, total extent is 187.544 m<sup>2</sup>, and it is divided into Seo-do and Dong-do (Ulleung-gun Journal, 2007). It was designated as a natural monument no. 336 'Dokdo Natural Reserve' in 1999, and it has a great academic value as it has not been influenced by human's activities and maintains natural biota.

As for the comprehensive research report on Ulleung-do and Dokdo, 'Comprehensive academic report on Ulleung-do and Dokdo' implemented by the Korean Association for Conservation of Nature in 1981 reported the biota of land and marine life in Ulleung-do and Dokdo (Korean Association for Conservation of Nature, 1981). Marine biota in Ulleung-do and Dokdo is different from that in the East Coast on the same latitude, and it is reported that the biota is rather similar to that in the South Coast such as Jeju Island due to the influence of warm current (Ministry of Maritime

Affairs and Fisheries, 1999). In Dokdo which was designated as a natural reserve, studies on marine life living in the intertidal zone are conducted constantly (Ministry of Environment, Daegu Office, 2007, 2008, 2009, 2010).

This study investigated the diversity of marine life living in the intertidal zone of Ulleung-do and Dokdo for twice in June and September, 2012 as a part of joint research of coalition of National Biodiversity Institutions, and it aims to complete a species list of benthic invertebrate living in the intertidal zone of Ulleung-do and Dokdo by arranging a species list revealed through this investigation and existing investigation records.

### Materials and Methods

The study selected 3 spots in the intertidal zone which is expected that various kinds of benthic invertebrate live (rocks in Jeodong Harbor, Tonggumi Mongdol Coast and Geobuk Bawi) and 1 spot in rocks of Dongdo Dock in Dokdo, and conducted total 2 times of investigation in June and September, 2012 (Fig. 1). Attached organisms living on rocks in the intertidal zone were collected using a chisel and a pair of tweezers. Specimens collected in Ulleung-do were anesthetized according to each taxon, fixed in 70% ethyl alcohol or 5~10% formalin on the spot, and researchers carried them to a specimen making room by each taxon and made the immersion specimen. Species investigated in Dokdo were photo shot, and if it was not possible, 1~2 specimens were collected and fixed by each taxon.

For deciding names, the study referred to Cnidaria

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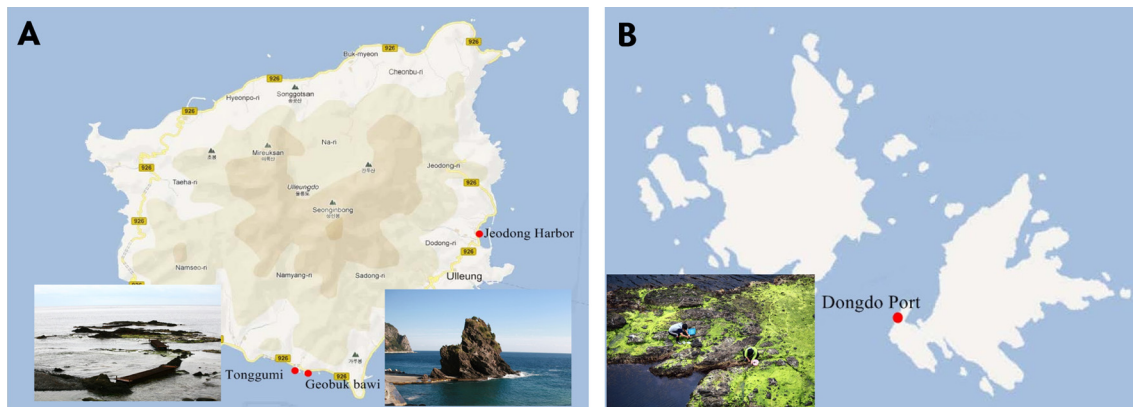


Fig. 1. Study area in Ulleungdo Island (A) and Dokdo Island (B).

(Song, 2004), Echinodermata (Shin and Noh, 1996), Mollusca (Choi, 1992; Min *et al.*, 2004), and Arthropoda (Kim, 1973), and used the taxonomy of the List of Animals in Korea (Korean Society of Systematic Zoology, 1997).

## Results

### List of species

Through this study, total 4 phyla, 7 classes, 13 orders 20 families and 26 species of benthic invertebrate were investigated in the rock intertidal zone of Dokdo, and as for the number of species by each taxa, the study investigated 14 species of mollusks (53%), 6 species of arthropod (23%), 3 species of echinoderm (12%) and 3 species of Cnidarian (12%). Total 4 phyla, 8 classes, 13 orders 23 families and 28 species of benthic invertebrate were investigated in the rock intertidal zone of Ulleung-do, and as for the number of species by each taxa, the study investigated 15 species of mollusks (54%), 6 species of arthropod (21%), 4 species of echinoderm (14%) and 3 species of Cnidarian (11%), showing that species diversity of mollusks was the highest.

Phylum Cnidaria 자포동물

Class Anthozoa 산호충강

Order Actiniaria 해변말미잘목

Family Actiniidae 해변말미잘과

1. *Actinia equina* 해변말미잘  
Material examined: Dokdo Island, 2012. 6. 28/2012. 9. 4  
Literature: Song (2004)
2. *Anthopleura japonica* 갈색꽃해변말미잘  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010; Song (2004)
3. *Anthopleura Kurogane* 검정꽃해변말미잘  
Material examined: Dokdo Island, 2012. 6.

28; Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5

4. *Anthopleura midori* 풀색꽃해변말미잘  
Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5

Phylum Mollusca 연체동물

Class Gastropoda 복족강

Order Neogastropoda 신복족

Family Muricidae 뿔소라

5. *Reishia bronni* 두드럭고둥  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29
6. *Reishia clavigera* 대수리  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29

Order Mesogastropoda 중복족목

Family Vermetidae 뱀고둥과

7. *Serpulorbis imbricatus* 큰뱀고둥  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29/2012. 9. 5  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010

Family Littorinidae 총알고둥과

8. *Granulittorina exigua* 좁쌀무늬총알고둥  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010

Order Archaeogastropoda 원시복족목

Family Trochidae 뱀고둥과

9. *Omphalius rusticus rusticus* 보말고둥

- Material examined: Dokdo Island, 2012. 6. 28  
Literature: Cha *et al.*, 1999
10. *Chlorostoma argyrostoma lischkei* 밤고둥  
Material examined: Dokdo Island, 2012. 6. 28  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010
  11. *Monodonta perplexa* 깔장각시고둥  
Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5; Jeodong Harbor, 2012. 9. 5
  12. *Chlorostoma argyrostoma turbinatum* 구멍밤고둥  
Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29, Jeodong Harbor, 2012. 9. 5
  13. *Omphalius pfeifferi carpenteri* 팽이고둥  
Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29
- Family Patellidae 삿갓조개과
14. *Cellana toreuma* 애기삿갓조개  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010
- Family Acmaeidae 흰삿갓조개과
15. *Notoacmea schrenkii* 배무래기  
Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29
- Family Turbinidae 소라과
16. *Turbo cornutus* 소라  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29
- Order Basommatophora 기안목
- Family Siphonariidae 고랑딱개비과
17. *Sacculosiphonaria japonica* 고랑딱개비  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29
  18. *Anthosiphonaria sirius* 꽃고랑딱개비  
Material examined: Dokdo Island, 2012. 6. 28
- Order Aplysiomorpha 군소목
- Family Aplysiidae 군소과
19. *Aplysia kurodai* 군소  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010
- Class Polyplacophora 다판강
- Order Neoloricata 신군부목
- Family Chitonidae 군부과
20. *Onithochiton hirasei* 비단군부  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29
- Family Acanthochitonidae 가시군부과
21. *Acanthochiton aachates* 좀털군부  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29
- Family Ischnochitonidae 연두군부과
22. *Ischnochiton* sp.  
Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5
- Class Bivalvia 이매패강
- Order Mytiloida 홍합목
- Family Mytilidae 홍합과
23. *Mytilus edulis* 진주담치  
Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5
- Order Pterioda 익각목
- Family Ostreidae 굴과
24. *Crassostrea gigas* 굴  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010
- Phylum Arthropoda 절지동물문
- Class Maxillopoda
- Order Thorcica 완홍목
- Family Tetracitidae 사각따개비과
25. *Tetracit japonica* 검은큰따개비  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Geobukbawi, 2012. 6. 27/2012. 9. 5  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010
- Family Balanidae 따개비과
26. *Megabalanus volcano* 큰빨강따개비  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Geobukbawi, 2012. 6. 27/2012. 9. 5
- Family Chthamalidae 조무래기따개비과
27. *Chthamalus challenger* 조무래기따개비  
Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Geobukbawi, 2012. 6. 27/2012. 9. 5  
Literature: Detailed investigation report on ecosystem in Dokdo, 2010

## Family Scalpellidae 거북손과

28. *Pollicipes mitella* 거북손

Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5

Literature: Detailed investigation report on ecosystem in Dokdo, 2010

## Class Malacostraca

## Order Decapoda 십각목

## Family Grapsidae 바위게과

29. *Pachygrapsus crassipes* 바위게

Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5

Literature: Detailed investigation report on ecosystem in Dokdo, 2010

## Family Paguridae 집게과

30. *Pagurus* sp.

Material examined: Ulleungdo Island, Tonggumi, 2012. 6. 29

## Order Isopoda 등각목

## Family Ligiidae 갯강구과

31. *Ligia exotica* 갯강구

Literature: Detailed investigation report on ecosystem in Dokdo, 2010

## Phylum Echinodermata 극피동물

## Class Echinoidea 성게강

## Order Echinoida 성게목

## Family Echinometridae 만두성게과

32. *Anthocidaris crassispina* 보라성게

Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29; Geobukbawi, 2012. 6. 27/2012. 9. 5

Literature: Detailed investigation report on ecosystem in Dokdo, 2010

## Family Strongylocentrotidae 등근성게과

33. *Hemicentrotus pulcherrimus* 말뚝성게

Material examined: Dokdo Island, 2012. 6. 28; Ulleungdo Island, Tonggumi, 2012. 6. 29

## Class Stelleroidea 불가사리강

## Order Spinulosida 유극목

## Family Asterinidae 별불가사리과

34. *Asterina pectinifera* 별불가사리

Material examined: Dokdo Island, 2012. 6.

Table 1. Benthic invertebrate appearing in the rock littoral zone of the dock in Dokdo

Taxon	Scientific name	Korean name	Dokdo	
			Ministry of Environment, Daegu Office (2010)	This study (2012)
Cnidarian	<i>Actinia equina</i>	해면말미잘		+
	<i>Anthopleura japonica</i>	갈색꽃해면말미잘	+	+
	<i>Anthopleura Kurogane</i>	검정꽃해면말미잘		+
Mollusks	<i>Reishia bronni</i>	두드럭고둥		+
	<i>Onithochiton hirasei</i>	비단군부		+
	<i>Acanthochitona achates</i>	좀털군부		+
	<i>Serpulorbis imbricatus</i>	큰뺨고둥	+	+
	<i>Omphalius rusticus rusticus</i>	보말고둥	+	+
	<i>Chlorostoma argyrostoma lischkei</i>	밤고둥	+	+
	<i>Reishia clavigera</i>	대수리		+
	<i>Aplysia kurodai</i>	군소	+	+
	<i>Granulilittorina exigua</i>	좁쌀무늬총알고둥	+	+
	<i>Crassostrea gigas</i>	굴	+	
	<i>Cellana toreuma</i>	애기삿갓조개	+	
	<i>Sacculosiphonaria japonica</i>	고랑딱개비		+
	<i>Anthosiphonaria sirius</i>	꽃고랑딱개비		+
	<i>Batillus cornutus</i>	소라		+
Arthropod	<i>Tetraclita japonica</i>	검은큰따개비	+	+
	<i>Megabalanus volcano</i>	큰빨강따개비		+
	<i>Chthamalus challengeri</i>	조무래기따개비	+	+
	<i>Pollicipes mitella</i>	거북손	+	+
	<i>Pachygrapsus crassipes</i>	바위게	+	+
	<i>Ligia exotica</i>	갯강구	+	
Echinoderm	<i>Anthocidaris crassispina</i>	보라성게	+	+
	<i>Hemicentrotus pulcherrimus</i>	말뚝성게		+
	<i>Asterina pectinifera</i>	별불가사리		+



28; Ulleungdo Island, Tonggumi, 2012. 6. 29/  
2012. 9. 5

Order Forcipulata 차극목  
Family Asteroiidae 불가사리과  
35. *Sclerasterias* sp.

Material examined: Ulleungdo Island,  
Tonggumi, 2012. 6. 29

### Comparison of species in Dokdo rock intertidal zone

In order to conduct comparative analysis on Dokdo rock intertidal zone, the study compared and analyzed species of the detailed investigation report on ecosystem in Dokdo (Ministry of Environment, Daegu Office, 2010) and of this study. As a result, benthic invertebrate additionally investigated in this study includes *Actinia equina*, *Onithochiton hirasei*, *Acanthochitona achates*, *Reishia clavigera*, *Sacculosiphonaria japonica*, *Anthosiphonaria sirius*, *Megabalanus volcano*, *Hemicentrotus pulcherrimus*, *Asterina pectinifera* and *Batillus cornutus* (Table 1).

### Comparison of species in Ulleung-do rock intertidal zone

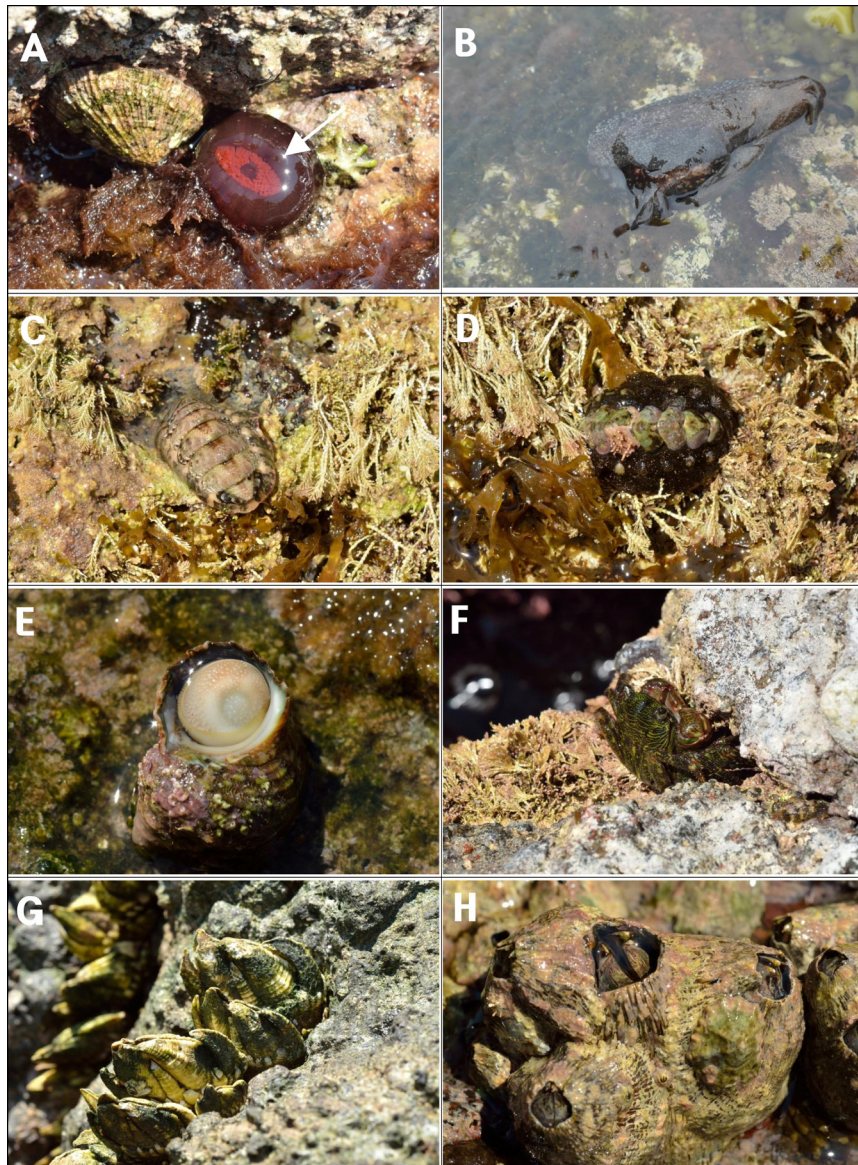
As a result of investigating benthic invertebrate in Ulleung-do rock intertidal zone, the study observed 3 species of cnidarian, 14 species of mollusks, 3 species of arthropod and 4 species echinoderm in Tonggumi Mongdol Coast, and 2 species of cnidarian, 5 species of mollusks, 5 species of arthropod and 1 species of echinoderm in the intertidal zone of Geobuk Bawi. In rocks of Jeodong Harbor, 2 species including *Monodonta perplexa* and *Chlorostoma argyrostoma turbinatum* were observed. It was shown that various kinds of zoobenthos were distributed around rocks of Tonggumi Mongdol Coast among the investigated spots (Table 2).

### Discussion

The study investigated benthic invertebrate in the intertidal zone of Ulleung-do and Dokdo as a part of joint research of coalition of National Biodiversity Institutions for twice in

**Table 2.** Benthic invertebrate appearing in the rock littoral zone in Ulleung-do

Taxon	Scientific name	Korean name	Ulleung-do		
			Tonggumi Mongdol Coast	Geobuk Bawi	Rock in Jeodong Harbor
Cnidarian	<i>Anthopleura japonica</i>	갈색꽃해변말미잘	+		
	<i>Anthopleura kurogane</i>	검정꽃해변말미잘	+	+	
	<i>Anthopleura midori</i>	푸른꽃해변말미잘	+	+	
Mollusks	<i>Acanthochitona achates</i>	좀털군부	+		
	<i>Onithochiton hirasei</i>	비단군부	+		
	<i>Reishia bronni</i>	두드럭고둥	+		
	<i>Reishia clavigera</i>	대수리	+		
	<i>Ischnochiton</i> sp.	군부류	+	+	
	<i>Serpulorbis imbricatus</i>	큰뿔고둥	+		
	<i>Granulilittorina exigua</i>	좁쌀무늬총알고둥	+	+	
	<i>Monodonta perplexa</i>	깜장각시고둥	+	+	+
	<i>Chlorostoma argyrostoma turbinatum</i>	구멍뿔고둥			+
	<i>Notoacmea schrenkii</i>	배무래기	+		
	<i>Omphalius pfeifferi carpenteri</i>	팽이고둥	+		
	<i>Siphonaria (Sacculosiphonaria) japonica</i>	고랑딱개비	+		
	<i>Batillus cornutus</i>	소라	+		
	<i>Aplysia kurodai</i>	군소	+	+	
	<i>Mytilus edulis</i>	진주담치	+	+	
Arthropod	<i>Pollicipes mitella</i>	거북손	+	+	
	<i>Tetraclita japonica</i>	검은큰따개비		+	
	<i>Megabalanus rosa</i>	큰빨강따개비		+	
	<i>Chthamalus challenger</i>	조무래기따개비		+	
	<i>Pagurus</i> sp.	집게류	+		
	<i>Pachygrapsus crassipes</i>	바위게	+	+	
Echinoderm	<i>Anthocidaris crassispina</i>	보라성게	+	+	
	<i>Hemicentrotus pulcherrimus</i>	말뚝성게	+		
	<i>Asterina pectinifera</i>	별불가사리	+		
	<i>Sclerasterias</i> sp.	단단불가사리류	+		



**Fig. 2.** Major benthic invertebrate in the intertidal zone of Dokdo. A. *Actinia equina*; B. *Aplysia kurodai*; C. *Onithochiton hirasei*; D. *Acanthochitona achates*; E. *Batillus cornutus*; F. *Pachygrapsus crassipes*; G. *Pollicipes mitella*; H. *Tetraclita japonica*.

June and September, 2012. As for Dokdo which is designated as a natural monument (no. 336), the study conducted in-depth investigation on one spot of rocks in Dongdo Dock which is expected to have many benthic invertebrate due to limited access and limited investigation time. As a result, additional species including *Actinia equina*, *Onithochiton hirasei*, *Acanthochitona achates*, *Reishia clavigera*, *Sacculosiphonaria japonica*, *Anthosiphonaria sirius*, *Megabalanus volcano*, *Hemicentrotus pulcherrimus* and *Asterina pectinifera* were observed comparing with species in the 'Detailed investigation report on ecosystem in Dokdo (Ministry of Environment, Daegu Office, 2010).' If detailed investigation with professionals in each taxon would be conducted in Dokdo intertidal zone, it is expected to find various benthic invertebrate.

As for Ulleung-do intertidal zone, there have been few investigation in the intertidal zone since the 'study on seasonal changes in benthic invertebrate in the intertidal zone of Ulleung-do and Dokdo (Cha JaeHun, Je JongGil and Kim GiTae, 1999).' As a result of investigating 3 spots of intertidal zone in Ulleung-do through this joint investigation, total 24 species of benthic invertebrates including 3 species of cnidarian, 14 species of mollusks, 3 species of arthropod and 4 species of echinoderm were observed in Tonggumi Mongdol Coast, and 2 species of cnidarian, 5 species of mollusks, 5 species of arthropod and 1 species of echinoderm in Geobuk Bawi. 2 species including *Monodonta perplexa* and *Chlorostoma argyrostoma turbinatum* were observed in rocks of Jeodong Harbor. It is expected that various kinds of benthic invertebrate will be





**Fig. 3.** Major benthic invertebrate in the intertidal zone of Ulleung-do. A. *Anthopleura japonica*; B. *Anthopleura midori*; C. *Aplysia kurodai*; D. *Monodonta perplexa*; E. *Megabalanus rosa*; F. *Chthamalus challengerii*; G. *Anthocidaris crassispina*; H. *Asterina pectinifera*.

observed in future systematic investigation in the intertidal zone of Ulleung-do.

## Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grant funded by Ministry of Science, ICT & Future Planning (MSIP) (NRF-2008-2004707).

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Received: 7. Mar. 2013

Revised: 13. Mar. 2013 / 18. Mar. 2013

Accepted: 19. Mar. 2013